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Malignant tumors of the spleen are uncommon, and primary splenic malignancies are extremely rare. The most common splenic malignancy is probably lymphoma, and it is usually a secondary involvement of systemic lymphoma. Primary splenic angiosarcoma is the second most common primary malignant tumor of the spleen following lymphoma. Spleen is an infrequent site for metastatic disease and usually appear late in the course of disseminated cancer. Radiologic findings are usually nonspecific, making correct diagnosis harder. Therefore, consideration of clinical findings and situation is mandatory for differential diagnosis.

25.1 Angiosarcoma

Angiosarcoma is a malignancy of vascular origin and is characterized by masses of endothelial cells with cellular atypia and anaplasia. Primary splenic angiosarcoma is rare, but it is the second most common primary malignant tumor of the spleen following lymphoma. It is found more frequently in older patients with no gender predilection. Unlike angiosarcomas of the liver, association with exposure to thorium dioxide (Thorotrast), arsenic, or vinyl chloride has not been documented. Symptoms and findings at initial presentation include abdominal pain, splenomegaly, and hemoperitoneum due to spontaneous rupture, anemia, and thrombocytopenia. The tumor commonly metastasizes to the liver, lung, and lymph nodes. Prognosis of angiosarcoma is poor with a mean survival time usually less than a year.

CT images may demonstrate an enlarged spleen with hypoattenuating lesions on noncontrast CT. Areas of high attenuation on noncontrast CT image may represent acute hemorrhage or hemosiderin deposits. Contrast enhancement of angiosarcoma may be similar to that of hepatic cavernous hemangioma, although the pattern of enhancement is variable.

MRI findings show general features of vascular tumors and hemorrhagic masses. The signal intensities on both T1- and T2-weighted images may vary, depending on the age of hemorrhage and presence of necrosis. Areas of low signal intensity on MRI represent siderotic nodules. Tumor usually enhances intensely after contrast media injection and may show fill-in pattern of enhancement similar to hemangioma.

25.2 Lymphoma

Lymphoma is probably the most common splenic malignancy and is usually a secondary involvement of systemic lymphoma. Primary splenic lymphomas are rare, and most of them are non-Hodgkin's lymphomas. The most common

finding is splenomegaly, but it may be absent in up to one-third of lymphoma patients.

There are two patterns of splenic involvement of lymphoma. In case of diffuse involvement or infiltration, enhanced CT image can show diffuse or infiltrative areas of poor enhancement. US may depict inhomogeneity of parenchymal echogenicity, but may not show any radiological abnormalities. Splenic lymphoma can also appear as focal lesions, showing masses or nodules of heterogeneous low echogenicity on US, low attenuation on noncontrast CT image, and poor enhancement after contrast media injection.

MRI findings are nonspecific and similar to those of metastases from other primary malignancies. Typically, splenic lymphomas are hypointense or nearly isointense on T1-weighted images and hyperintense on T2-weighted images. Splenic lymphomas can be better depicted with contrast enhancement as lymphoma shows poor enhancement in contrast to background parenchymal enhancement of the spleen.

25.3 Metastasis

Spleen is an infrequent site for metastatic disease, although the frequency of splenic metastases may have been underestimated as they are often asymptomatic and usually appear late in the course of disseminated cancer. Solitary metastases to the spleen are rare. Common primary malignancies of splenic metastases are breast, lung, colorectal, ovarian, and gastric carcinomas and malignant melanomas. Solitary splenic metastasis occurs most often in ovarian carcinomas.

Radiologic findings are nonspecific and similar to those of metastases of other organs. Splenic metastases are typically presented as lesions of low echogenicity on US, low attenuation on portal phase CT image, low signal intensity on T1-weighted MRI, and high signal intensity on T2-weighted MRI. MRI is more accurate for the detection of splenic metastases with hemorrhage or necrosis.

25.4 Summary

1. Malignant focal lesions in the spleen are rare and usually show nonspecific radiologic findings.
2. The most common splenic malignancy is probably lymphoma, followed by splenic angiosarcoma.
3. Splenic metastases are uncommon and usually appear late in the course of disseminated cancer.
4. Splenic angiosarcomas show radiologic features of vascular tumors and hemorrhagic masses.
5. Splenic lymphomas and metastases show usual radiologic features of metastatic lesions of other organs.

25.5 Illustrations: Malignant Focal Lesions of the Spleen

25.5.1 Splenic Angiosarcoma with Spontaneous Rupture

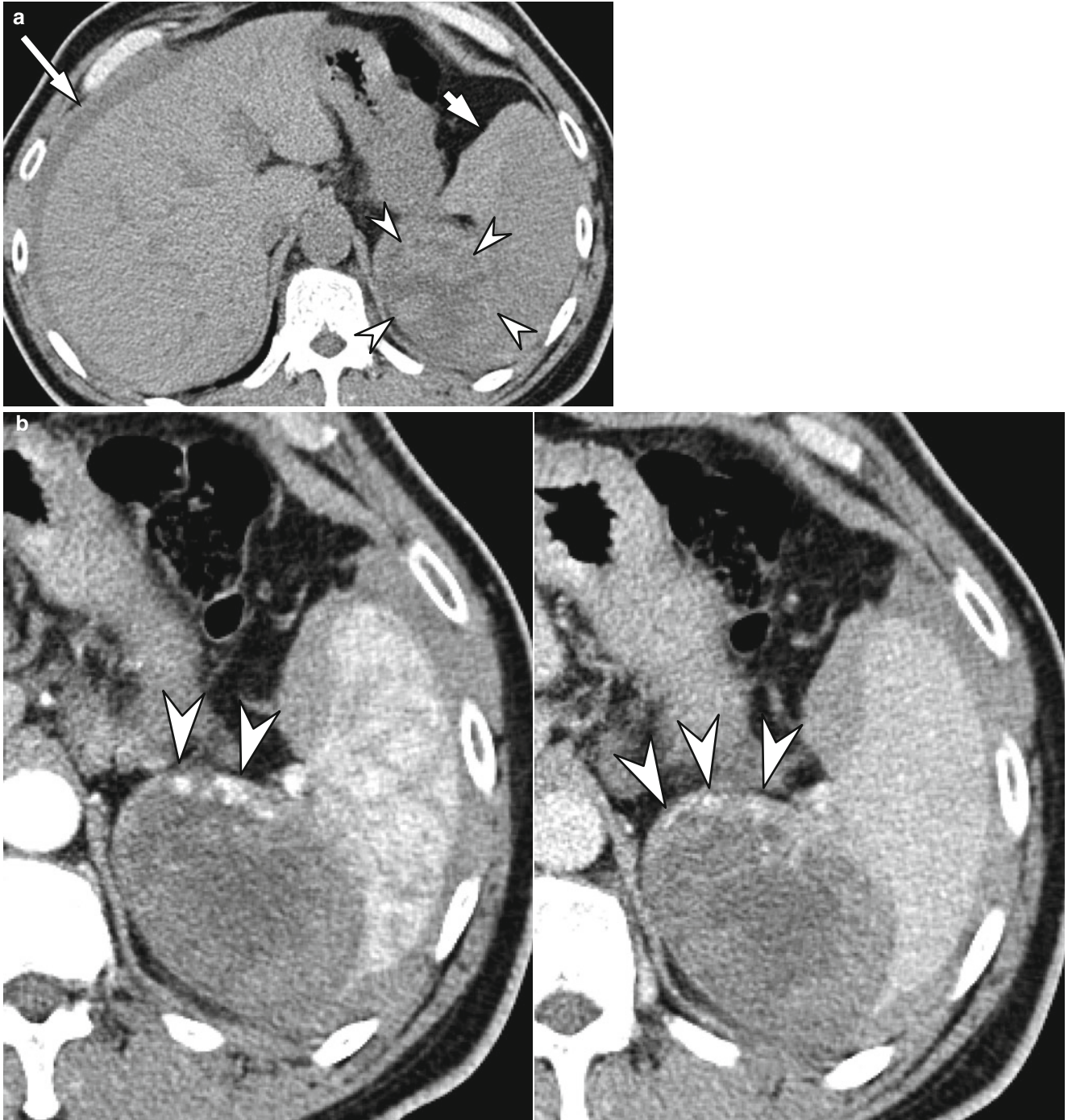


Fig. 25.1 Splenic angiosarcoma with spontaneous rupture in a 41-year-old male. (a) Noncontrast transverse CT image shows acute hematoma (*short arrow*) in the perisplenic space and hemoperitoneum in the perihepatic space (*long arrow*). A large mass lesion is also noted

in the spleen. The portion of high attenuation (*arrowheads*) in the tumor suggests intratumoral hemorrhage. (b) Arterial (*left*) and portal (*right*) phase transverse CT images show peripheral enhancement of the mass (*arrowheads*)

25.5.2 Splenic Angiosarcoma Involving Whole Spleen

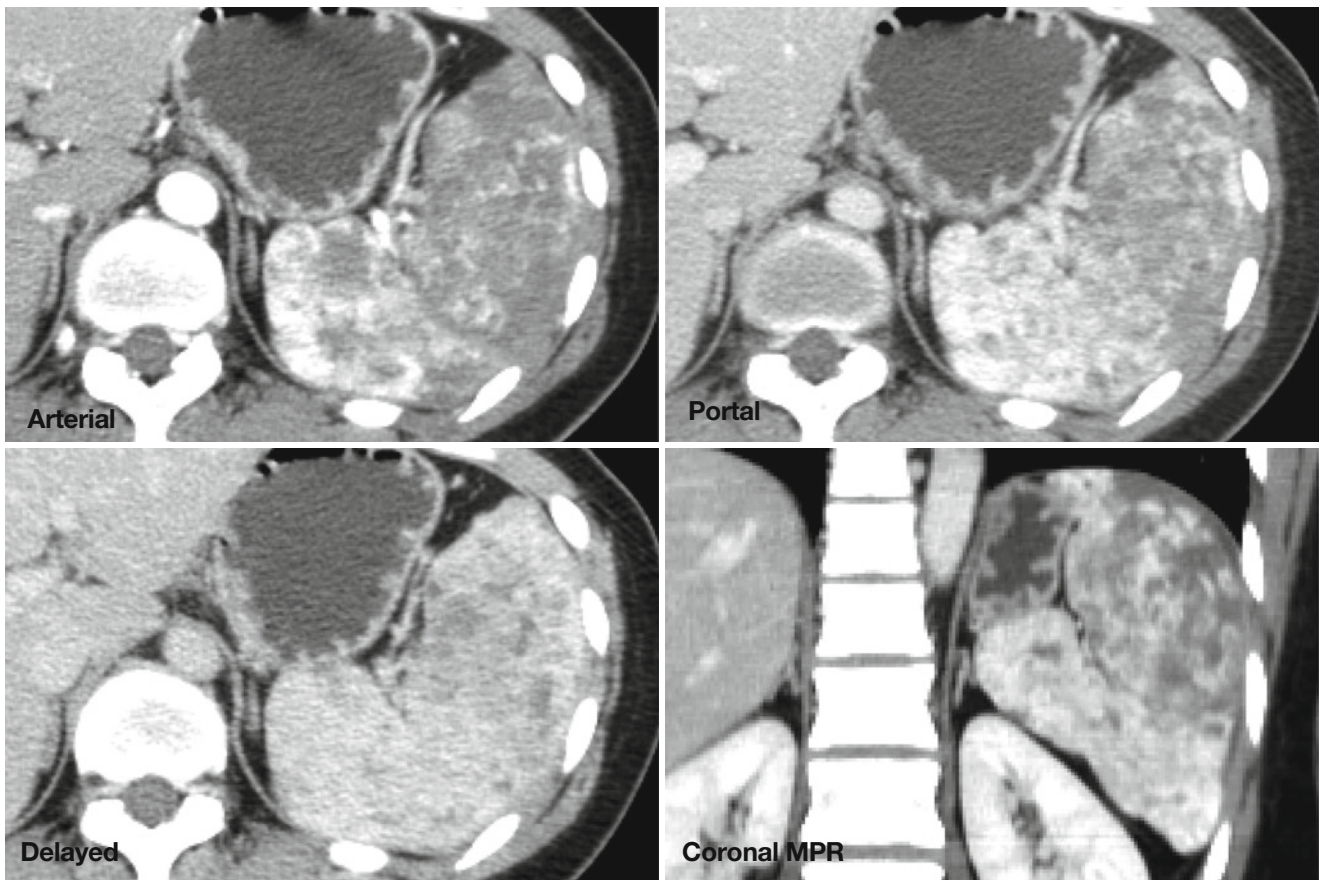


Fig. 25.2 Splenic angiosarcoma in a 33-year-old female. Dynamic contrast-enhanced transverse CT images demonstrate a heterogeneously enhancing mass-like lesion replacing nearly whole portion of the enlarged spleen

25.5.3 Splenic Angiosarcoma: MR Finding

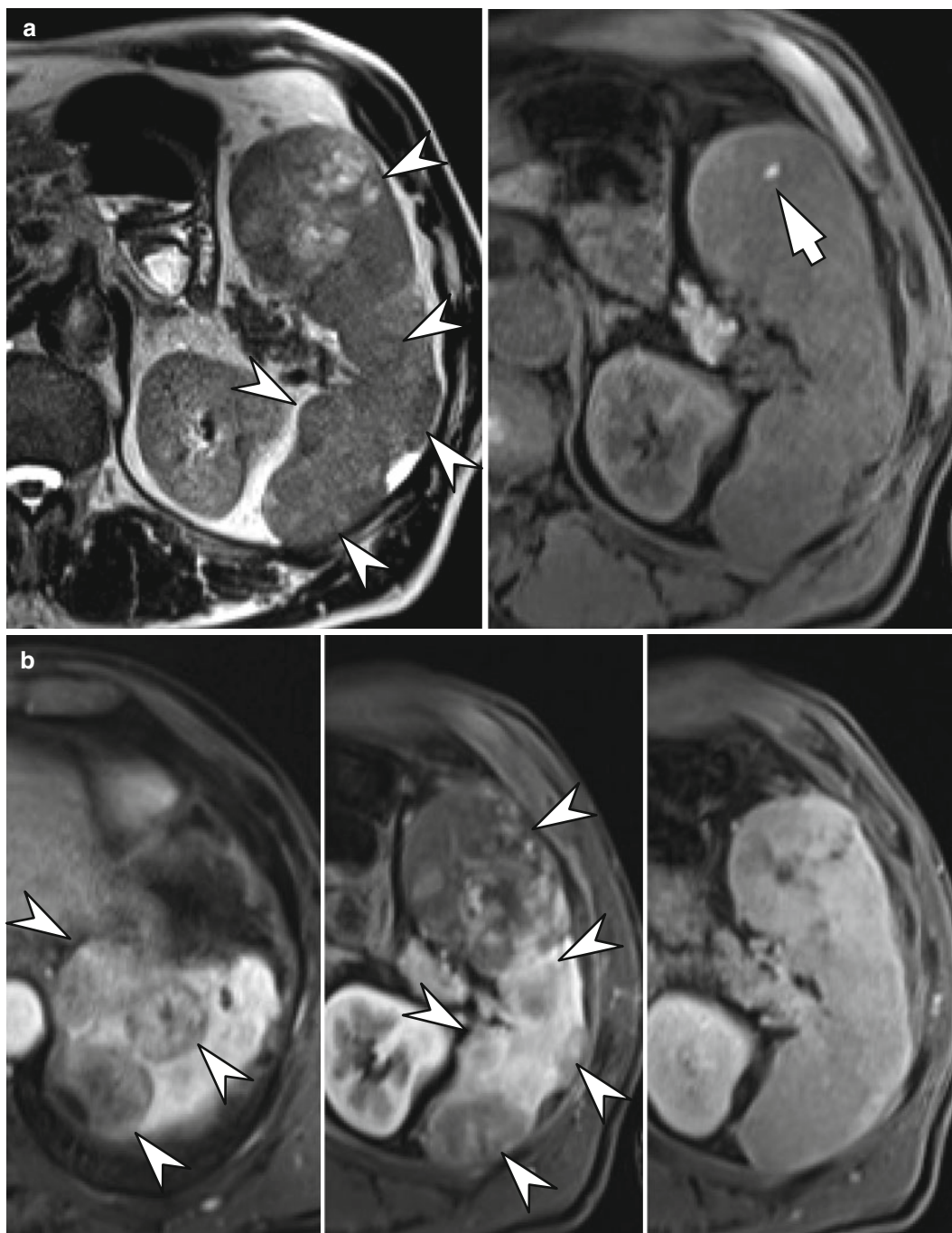


Fig. 25.3 Splenic angiosarcoma in a 63-year-old male. (a) T2-weighted transverse MRI (left) shows multiple masses (arrowheads) of variable signal intensities in the spleen. A bright dot (arrow) on fat-saturated T1-weighted transverse MRI (right) suggests intratumoral hemorrhage. (b) Contrast-enhanced portal phase T1-weighted transverse MRI

(left and middle) clearly depict multiple splenic masses (arrowheads). Delayed phase (right) T1-weighted transverse MRI taken at 20 min after contrast media injection shows a delayed fill-in enhancement pattern of the masses

25.5.4 Splenic Lymphoma with Diffuse Involvement

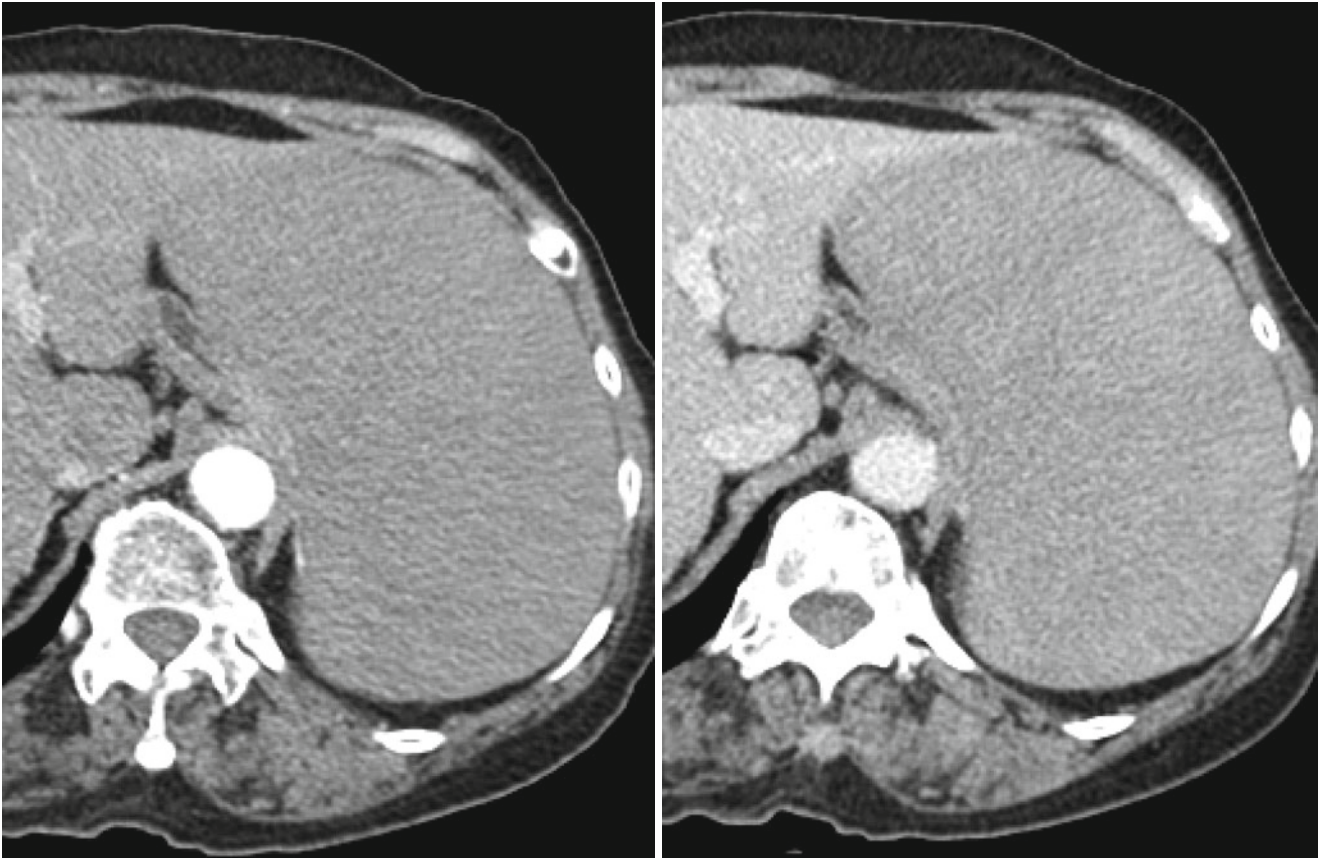


Fig. 25.4 A 72-year-old female with diffuse large B-cell lymphoma. Splenomegaly with diffuse low attenuation is noted both on arterial (*left*) and portal (*right*) phase CT images. There is no discernible focal lesion in the spleen

25.5.5 Splenic Lymphoma Appeared as a Focal Mass

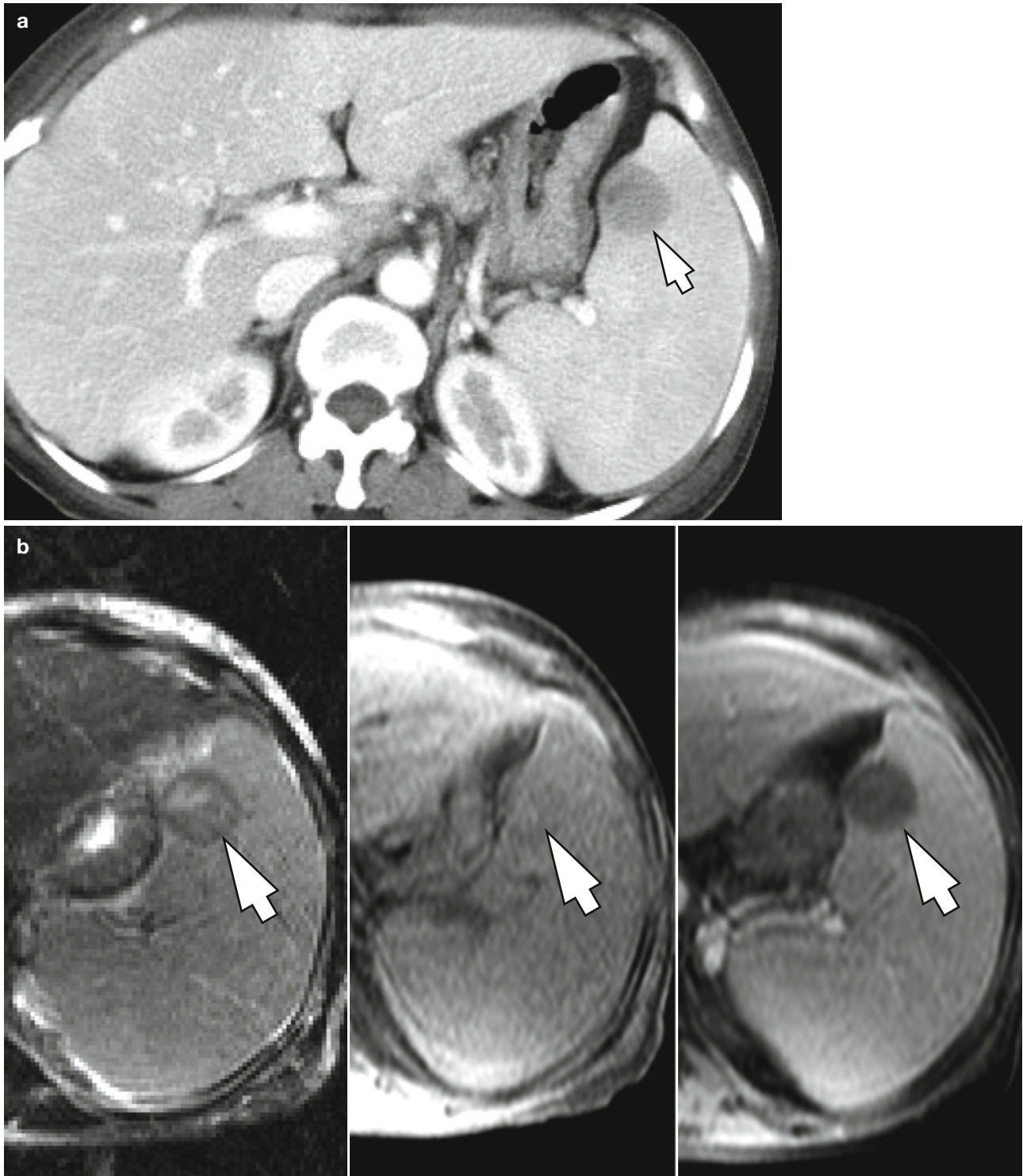


Fig. 25.5 A 77-year-old female with diffuse large B-cell lymphoma. (a) Contrast-enhanced transverse CT image demonstrates a 2.5 cm hypoattenuating mass (arrow) in the spleen. (b) The lesion (arrows) shows heterogeneous high signal intensity on T2-weighted transverse

MRI (left), slightly low signal intensity on fat-saturated T1-weighted transverse MRI (middle), and poor enhancement after gadolinium injection (right). Note better visualization of the lesion on the enhanced image

25.5.6 Splenic Metastasis of Nasopharyngeal Carcinoma: CT and US Findings

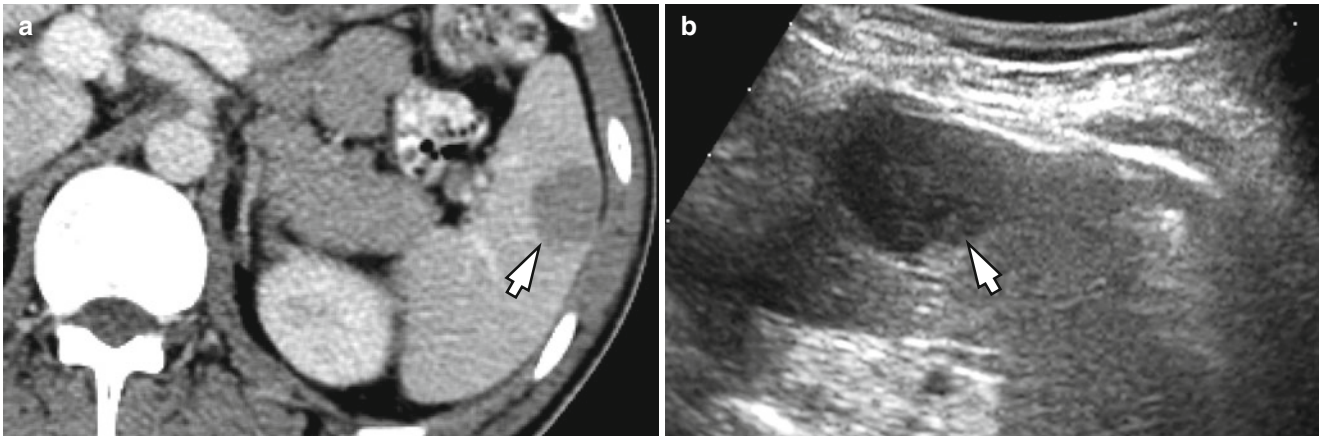


Fig. 25.6 Splenic metastasis of nasopharyngeal carcinoma in a 37-year-old male. (a) Contrast-enhanced transverse CT image shows a 2.5 cm hypoattenuating mass (*arrow*) in the spleen. (b) On grayscale US, the lesion appears as a hypoechoic lesion (*arrow*)

25.5.7 Splenic Metastasis of Endometrial Adenocarcinoma: CT and MRI Findings

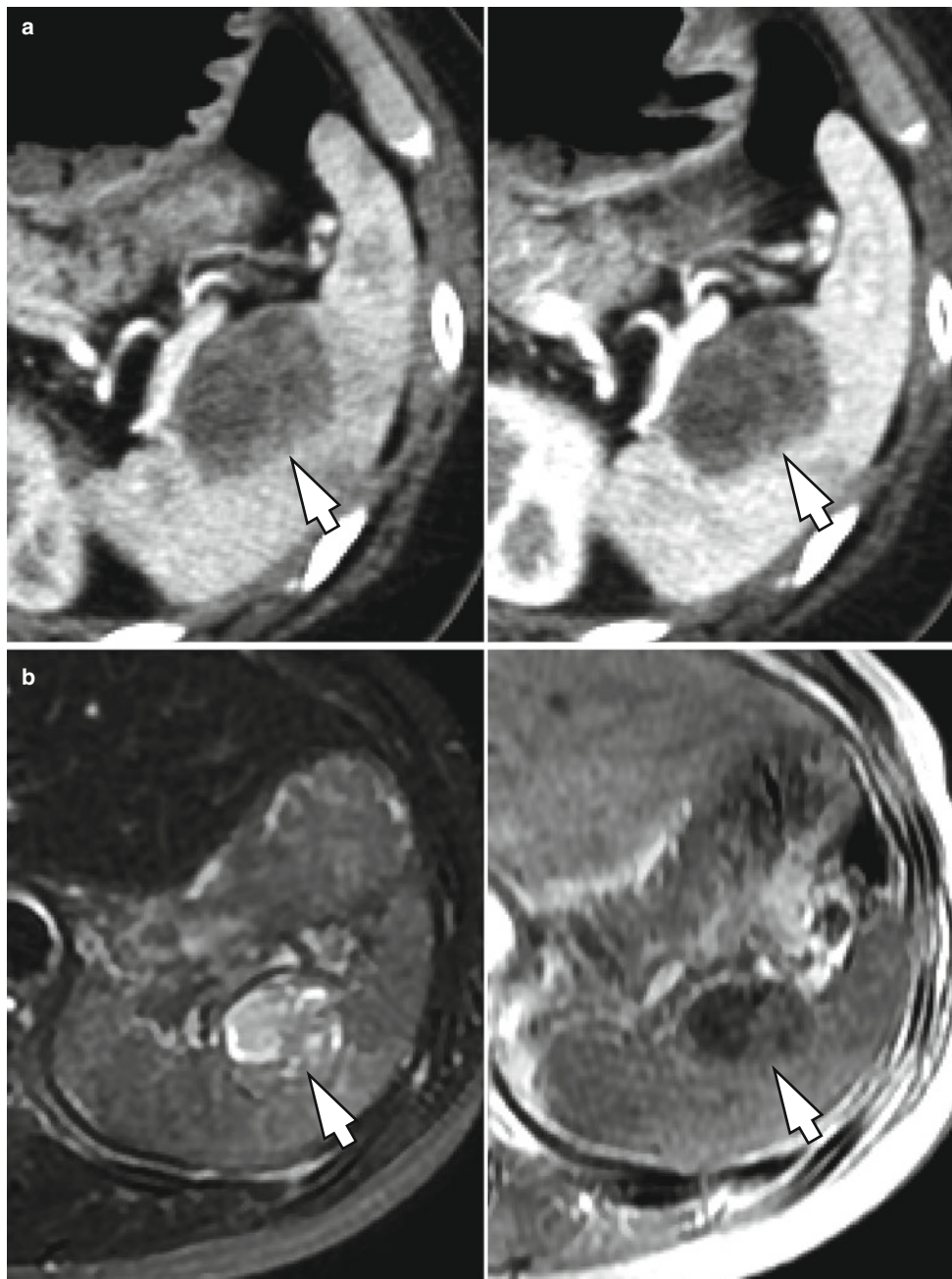


Fig. 25.7 Splenic metastasis of endometrial adenocarcinoma in a 59-year-old female. **(a)** Arterial (*left*) and portal (*right*) phase transverse CT images demonstrate a 3 cm heterogeneously and poorly enhancing mass (*arrows*) in the spleen. **(b)** The lesion (*arrows*) shows heterogeneous high signal intensity on T2-weighted transverse MRI

(*left*) and heterogeneous low signal intensity on T1-weighted transverse MRI (*right*). **(c)** Arterial (*left*) and portal (*right*) phases of enhanced MRI depict heterogeneous enhancement of the lesion, which is similar to that on the enhanced CT images

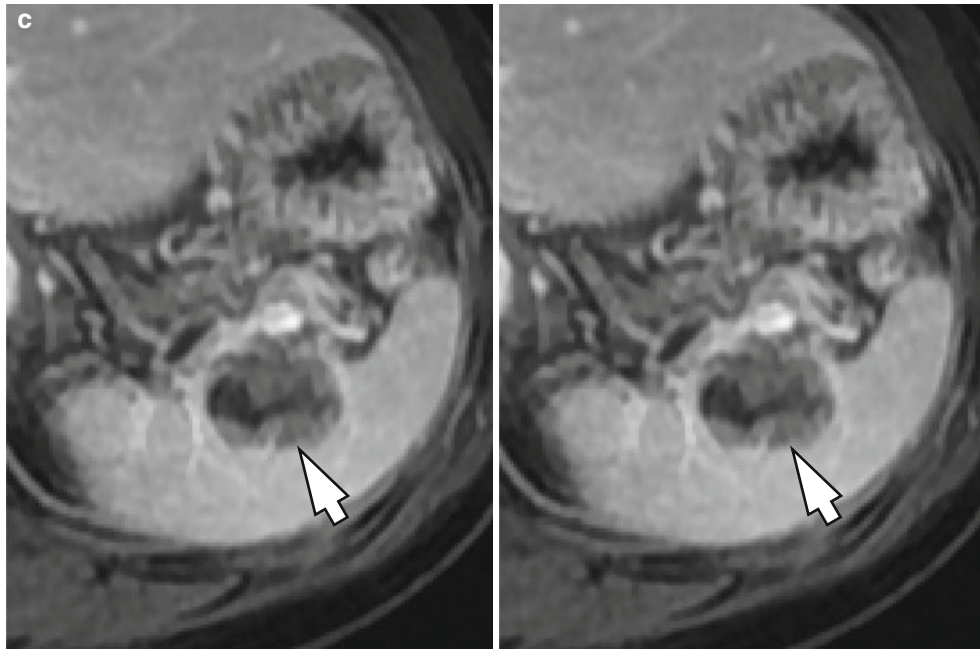


Fig. 25.7 (continued)

25.5.8 Splenic Metastasis of Hepatocellular Carcinoma: CT and MRI Findings



Fig. 25.8 Splenic metastasis of hepatocellular carcinoma in a 56-year-old male. (a) Arterial (left) and portal (right) phase CT images show a 2 cm poorly enhancing mass lesion (arrows) in the spleen. (b) Liver MRI taken on 1 month after CT. The diameter of the lesion (arrows) has increased from 2 to 3 cm. T2-weighted transverse MRI (left) shows heterogeneous signal intensity, and T1-weighted transverse MRI (right) shows nearly same signal intensity with that of the spleen. (c) With contrast media enhancement using Primovist, the lesion (arrows) is

poorly enhancing on the dynamic phases and demonstrates mild high signal intensity (arrowhead) on the hepatobiliary phase. This high signal intensity on the hepatobiliary phase is thought to be correlated with the hepatocellular nature of the metastatic lesion. Note that this splenic metastasis of hepatocellular carcinoma does not show typical enhancement patterns of hepatic hepatocellular carcinoma such as arterial hypervascularity and delayed washout

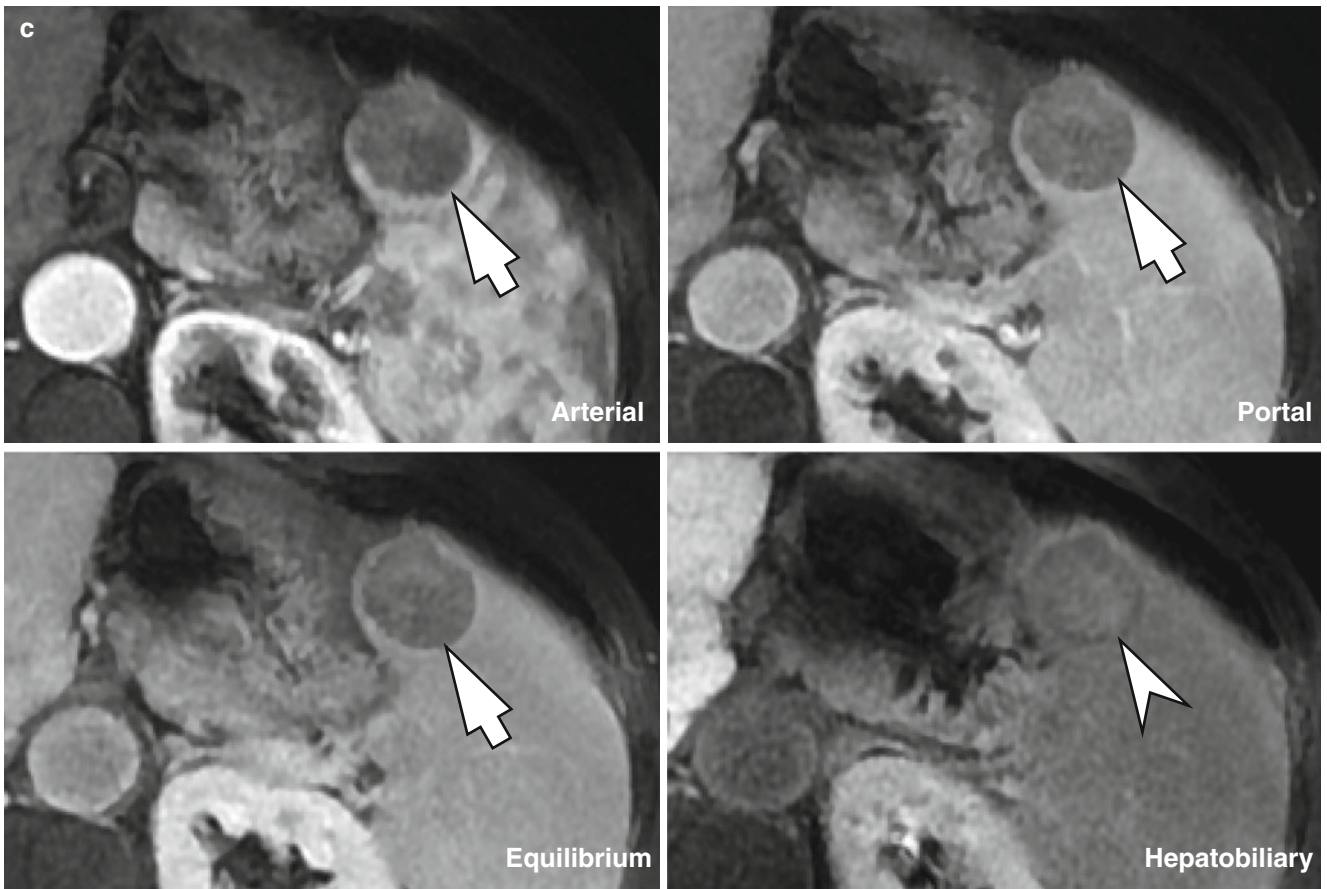


Fig. 25.8 (continued)

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